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Does mineral surface area affect chemical weathering rates?

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Iceland is a basaltic volcanic island representative of the high relief, volcanic and tectonic active islands that contribute over 45% of river suspended material to the oceans worldwide (Milliman and Syvitski, 1992). These islands have enormous mechanical and chemical weathering rates due to the combined effects of high relief, high runoff, the presence of glaciers and easily weathered volcanic rocks, and a lack of sedimentary traps. In total, Iceland delivers 0.7% of the worldwide river suspended matter flux to the ocean, which is approximately one fourth that of Africa (Tómasson, 1990). River suspended matter from volcanic islands is highly reactive in seawater and might play an important role in the global carbon cycle (Gislason et al., 2006). Thus it is important to define and understand the mechanical and chemical weathering rates of these islands.
Experimental dissolution experiments performed in the laboratory suggest that chemical weathering rates should be proportional to rock-water interfacial surface area. This hypothesis is tested in the present study through a study of the chemical composition of suspended material collected from rivers located in Northeast Iceland. These rivers were selected for this study because their catchments essentially monolithic, consisting of uniform compositioned and aged basalts. Gaillardet (1999) described weathering intensities of the worlds river systems to be from 1 (low weathering intensity) to 25 (high weathering intensity). These indexes were calculated to be from 1.8 to 3.2 in rivers in NE-Iceland (Eiriksdottir et al., 2008). The surface area of sediments is inversely proportional to particle size; smaller particles have larger specific surface areas. As a result, smaller particles should weather faster. This trend is confirmed by the measured compositions of analyzed suspended material. The concentration of insoluble elements (Zr, Fe, Cu, Ni, Y) is found to increase in the suspended material, whereas the concentration of soluble elements (Na, Ca, Ba, V) decrease with decreasing particle size in samples collected from various catchments.

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